Los Alamos
Inertial Confinement Fusion

August 1997 Progress Report

Fabrication: Notable progress in target fabrication occurred in three areas — Cryogenic layering R&D, Be capsule development, and target deliveries. Cryo experiments are being performed that check DT layer roughness in a Be torus and a copper torus as a function of tritium concentration. Layers in the Be torus so far are as smooth as those found in copper, and reducing the tritium concentration from 95% to 60% shows no obvious effect on smoothness. Be capsule development took strides in samples coated with copper to enhance diffusion bonding, and, after bonding, the copper joint was undetectable by transmission electron microscopy. In a subsequent experiment, similar Be test parts were successfully bonded in an Ar + 6% H_2 atmosphere, indicating capsules be diffusion bondable in the presence of the fill gas. Finally, two new targets were fabricated for on-going experiments - cylinders with sinusoidal perturbations produced with the Fast Tool Servo designed and built for us by NC State, and thin-wall, gas-filled re-emission targets.

Target Physics: Bob Peterson from the University of Wisconsin spent the summer analyzing data from Nova experiments studying the smoothing effect of kinoform phase plates on beam bending in scale one gas filled hohlraums. He found that calculations of imploded capsule symmetry agreed with the measured symmetry, suggesting that beam bending has been substantially reduced by the use of kinoform phase plates. He also found the data shows the laser spot size narrows with time, while his calculations suggest it spreads.

Bob Goldman and Steve Caldwell performed a preliminary analysis of Nova planar experiments exploring joint physics. The experiment included 15 microns thick joints filled with aluminum or plastic in 150 micron thick beryllium-copper (10 wt % Cu) foils. The aluminum joint-fill and the plastic joint-fill mock up high density joint and low density perturbations, respectively. The shock close to the joint lags behind the shock far from the joint, by a distance roughly equal to the joint width in the aluminum experiment. This lag vanishes at a lateral distance from the joint of $c_s t$ (sound speed times the time since the shock entered the material). For our experimental conditions, this was about ten times the joint thickness. For a plastic joint, the shock front and the ablation front lead in the joint. This produces a complex behavior where a shock leads in the material near the joint, but a lower pressure is generated behind the ablation front in the plastic and ahead of the ablation front in the Be/Cu. The data compares well with calculations for both scenarios.

Gold hohlraum calculations have usually been done with crude hydrogenic average-atom opacity models. A superior method, namely the use of DCA (Detailed Configuration Accounting) to calculate non-LTE opacities for high-z elements, has traditionally been stymied by the complexity of the atomic model required for the simulation, as well as the computer time involved. We have recently developed an in-line atomic-model-building capability which: a) uses principal quantum number only for kinetics (no fine structure); b) allows for arbitrary numbers of excited electrons and holes; c) allows for fine structure where the principal quantum number(Δn) is not equal to 0 transitions, as well as Δn=0 transitions for opacities (only). We have done representative calculations for Au sphere blowoff experiments. A large amount of work has gone into multitasking the DCA package and obtaining timing results. Eventually this work should give us the capability to do more accurate non-LTE hohlraum calculations

NIF: Los Alamos technical staff continue to work with Livermore personnel on the design of the LM-1 and Periscope structures. This summer both subsystems completed a 65% Title II review. Los Alamos is also designing two robotic systems: the target chamber robot and the roving mirror assembly for the beam transport switchguards.

Los Alamos engineers are completing thermal analysis of the laser beam tubes and the final optics assemblies. Thermal loading from the target bay/switchguard lights has been found to be a potential perturbation source affecting optical beam quality for some beamlines. LANL and LLNL engineers are working together to alleviate the problem.